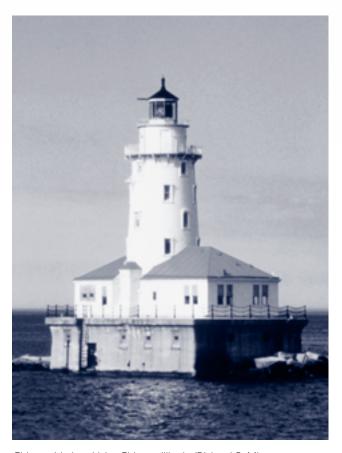*Chapter 7* | Great Lakes
Coastal Condition

Great Lakes Coastal Condition

The overall condition of the Great Lakes is fair to poor, based on the Great Lakes Index (Figure 7-1). The Great Lakes National Program Office (GLNPO) has been monitoring the open waters of the Great Lakes (approximately 94,250 square miles) annually since 1983. It has collected water and biota biannually from specified water depths from a limited number of locations in each of the five Great Lakes. This monitoring effort was designed to provide data to (1) assess the state of water quality in open lake basins (more than 100 feet in depth or more than 3 miles from shore); (2) detect and evaluate trends and changes in chloride, nitrate nitrogen, silica, phytoplankton, total phosphorus, chlorophyll *a*, and Secchi disk depth; (3) verify or modify water quality models; and (4) estimate the trophic index for each lake. The GLNPO also sampled sediments from select shallow and deepwater locations to characterize benthic communities. Other special-purpose sampling programs focused on known or suspected problem areas, such as the Great Lakes AOCs and rivers and harbors, to determine, for example, whether contamination was increasing or decreasing in sediments and whether remediation efforts were feasible and effective.

State of the Lakes Ecosystems Indicators	Numerical Rating				
	1	2	3	4	5
1. Water Clarity				■	
2. Dissolved Oxygen					■
3. Coastal Wetlands		■			
4. Water Quality Index*			■		
5. Eutrophic Condition		■			
6. Sediment Contamination	■				
7. Benthic Health		■			
8. Fish Tissue Contaminants			■		
9. Phosphorus Concentrations			■		
Beach Closures			■		
Drinking Water Quality				■	
Air Toxics Deposition			■		

Figure 7-1. The overall condition of the Great Lakes based on these indicators is fair to poor. (The numbered indicators are similar to those used in the NCA Program, with poor referenced as 1 or red, and good referenced as 5 or dark green. The Water Quality Index [#4] is not part of the SOLEC indicators and was constructed for a more direct comparison to the water quality indices used in this report. It is a combination of SOLEC indications—Water Clarity [#1], Dissolved Oxygen [#2], Eutrophic Condition [#5], and Phosphorus Concentrations [#9].)

Chicago Harbor Light, Chicago Illinois (Richard B. Mieremet, Senior Advisor, NOAA OSDIA).

Lake Michigan waterfront Chicago, Illinois (Richard B. Mieremet, Senior Advisor, NOAA OSDIA).

Houghton County, Lake Superior, Michigan (Richard B. Mieremet, Senior Advisor, NOAA OSDIA).

Coastal Monitoring Data

Although the Great Lakes have an extensive monitoring network, Great Lakes monitoring is not directly comparable with monitoring done under the NCA Program. The Great Lakes Program uses best scientific judgment to select monitoring sites that represent overall condition of the Great Lakes, whereas the NCA Program uses a probabilistic survey design to represent overall ecosystem condition in order to attain a known level of uncertainty. Because the two programs use different methods, spatial estimates of coastal condition cannot be calculated for the Great Lakes that are consistent with those calculated for the Northeast Coast, Southeast Coast, West Coast, and Gulf Coast regions, nor can estimates for the Great Lakes be compared with those for other regions with a known level of confidence. The comparability of these estimates, however, was recently improved by efforts of the GLNPO and Great Lakes scientists to assess the overall status of eight ecosystem components of the Great Lakes, some similar to NCA indicators. The results of these efforts, along with relevant technical information from the SOLEC (http://www.epa.gov/grtlakes/solec/) and GLNPO (http://www.epa.gov/glnpo/), are used to quantify and categorize NCA condition indicators for the Great Lakes. The condition values are based primarily on expert opinion, and they are integrated with other regional condition data to evaluate the overall condition of the nation's coastal environment.

Water Quality Index

In order to more readily compare the SOLEC findings for the ecological condition of the Great Lakes with the NCA findings for U.S. estuaries, several SOLEC indicators (eutrophic condition, water clarity, dissolved oxygen, and phosphorus concentrations) were combined into a water quality index. Of these indicators, one is fair to poor (eutrophic condition), two are fair (water clarity and phosphorus concentrations), and one is good (dissolved oxygen). The same general approach used for NCA data to calculate water quality index ratings was used to calculate the water quality index rating for the Great Lakes, and water quality is rated fair.

Eutrophic Condition

Eutrophic condition in the Great Lakes is rated fair to poor. The GLNPO used a surface water quality index developed by Chapra and Dobson (1981), based on an assumed direct relationship between phosphorus concentrations, chlorophyll *a*, and Secchi depth (clarity), to describe the water quality condition of offshore waters.

Data collected during the 1990s indicate that the trophic condition of Lake Superior, the deepest and coldest of the Great Lakes, is good (oligotrophic—low in nutrients, high in water clarity, and low in productivity), and trends do not suggest future problems. For the remaining Great Lakes, data to calculate trophic-state indices date back to the 1980s and provide a long-term trend. The waters of Lakes Michigan and Huron, the second and third largest of the Great Lakes, respectively, were determined to be good (oligotrophic), with indications that conditions are improving. Lake Ontario, the fourth largest lake, is oligomesotrophic (having both oligotrophic and mesotrophic characteristics over time), with indications that conditions are improving. Lake Erie, the smallest of the Great Lakes, has three distinct basins. The Eastern Basin, the deepest of the three basins, is oligotrophic (good). The Central Basin has characteristics of both oligotrophy and mesotrophy (moderately low in nutrients, moderate in water clarity, and of moderate productivity) and experiences oxygen depletion at deeper depths during the summer months. The Western Basin, the shallowest basin, is classified as mesotrophic, with large annual fluctuations in the index obscuring any trends.

Nutrients: Phosphorus

The condition of the Great Lakes as measured by nutrient concentrations is fair. Average phosphorus concentrations in the open waters of Lakes Superior, Michigan, Huron, and Ontario are at or below guideline levels established by the Great Lakes Water Quality Agreement (Figure 7-2). Offshore waters of Lakes Ontario and Huron meet the guidelines, but some nearshore areas exceed the guidelines, potentially promoting growth of nuisance algae. Phosphorus concentrations in all three basins of Lake Erie exceed the guidelines. Four of six lake basins have total phosphorus concentrations at or below guideline levels; consequently, Great Lakes scientists rank phosphorus concentrations as fair. This indicator, however, is measured in the open waters of the Great Lakes. If phosphorus were measured in nearshore coastal areas (the subject of this report) rather than in open water, the indicator would likely rank lower in condition.
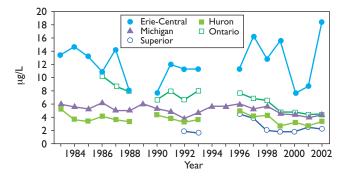

Figure 7-2. Total phosphorus concentrations in the open waters of the Great Lakes (GLNPO, 2003).

Water Clarity

Water clarity, measured by Secchi disk, is good to fair in the Great Lakes. It has increased in all lakes over the last decade, except for Lake Erie. Secchi disk measurements of light penetration in Lake Ontario, for example, increased nearly 100% during the 1990s. Increased water clarity, although visually pleasing, may not be a good indicator of improving conditions in the Great Lakes because increased water clarity is also an indicator of reductions in algal populations, which are the food base for the aquatic food chain.

Turbidity data are often collected in nearshore waters in order to measure water clarity and drinking water quality. Based on data from 98 reporting stations in the Great Lakes Basin collected between 1999 and 2001, the most turbid waters were from the Great Lakes, connecting rivers, and inland rivers; inland lakes and ground waters were less turbid. The trend in turbidity declined during this period, with Lakes Ontario, Superior, and Huron having the least turbid waters during this 3-year period.

Dissolved Oxygen

Dissolved oxygen conditions in the Great Lakes are generally good; however, dissolved oxygen in the central basin of Lake Erie continues to be a persistent problem. Anoxic conditions (< 0.5 mg/L) often occur in late August and continue until turnover occurs in the fall. The frequency and extent of oxygen depletions decreased considerably from the 1970s, leveled off in the late 1990s, and may now be increasing again. This may be due to the invasion of non-native species that have modified Lake Erie's ecosystem function and affected dissolved oxygen concentrations.

Sediment Quality Index

The condition of sediments in Great Lakes harbors and tributaries is poor. Contaminated sediments currently affect beneficial uses at all 31 of the AOCs in the U.S. Great Lakes (Figure 7-3). Sediment contamination contributes to 11 of 14 beneficial use impairments, including a wide range of recreational, habitat, economic, and environmental impairments. Contaminated sediments in the AOCs are the leading cause of fish consumption advisories. Contaminated sediments in the AOCs requiring remediation are roughly estimated to be between 10 and 30 million cubic yards. Sediment contaminants in the AOCs also serve as a source of contaminants to the open waters as a result of sediment resuspension activities, such as storm events. Great Lakes scientists rank sediment contamination by examining the percentage of contaminated sediment volume that has been remediated. Sediment contamination in the AOCs is rated poor because less than 10% of the contaminated sediment volume has been remediated. This poor rating only applies to the most problematic
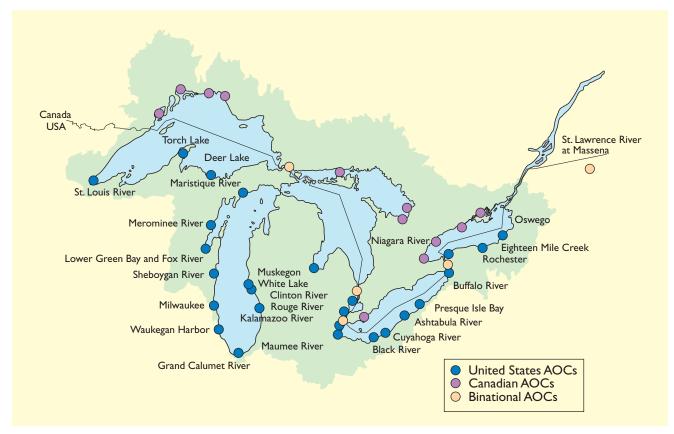

Figure 7-3. Great Lakes Areas of Concern (AOCs) (GLNPO, 2004).

Great Lakes areas and is not intended as an overall assessment of the sediments of the Great Lakes.

The GLNPO assesses the levels of contaminants in rivers and harbors of the Great Lakes to support sediment-based mass balance modeling activities, to promote remediation of sediment contaminants, and to assist in developing sediment policies for the Great Lakes. The results of sediment assessments conducted in 1999 showed that approximately 60% of the sediments sampled in Great Lakes rivers and harbors were considered "probably toxic" because of PCBs, 20% were considered not toxic, and 20% were considered to have uncertain toxicity (Figure 7-3).

Benthic Index

Sediment condition in the Great Lakes as measured by benthic condition is fair to poor. The benthic invertebrates *Diporiea* and *Hexagenia* have historically been sampled because of their importance at the base of the food web. *Diporiea* is an indicator in cold, deepwater habitats, and *Hexagenia* is an indicator of a healthy mesotrophic environment. Nine monitored areas—

the deepwater environment of each lake plus four mesotrophic habitats (western Lake Erie, the Bay of Quinte, Saginaw Bay, and Green Bay)—provide the basis for evaluating benthic health. Only two to four of the monitored areas have healthy, sustainable populations of *Diporiea* or *Hexagenia*; consequently, SOLEC scientists rank benthic health for the Great Lakes as poor (Figure 7-4).

The GLNPO initiated a benthic invertebrate biomonitoring program in 1997 to complement its ongoing surveillance sampling (Figure 7-5). All five lakes were sampled for macroinvertebrates and sediment chemistry at a minimum of 45 sampling stations; nearshore (< 165 ft depth) and offshore (> 165 ft depth) stations were sampled to evaluate both large, basin-wide changes (offshore) and more local changes (nearshore). The results demonstrated that, overall, most sites were taxa poor, with a maximum of 7 to 10 taxa per site and a minimum of 1 to 5 taxa per site. Greater numbers of taxa were found in the lower lakes, with the greatest number in Lake Erie, most likely because Lake Erie has a greater number of shallow sampling sites.
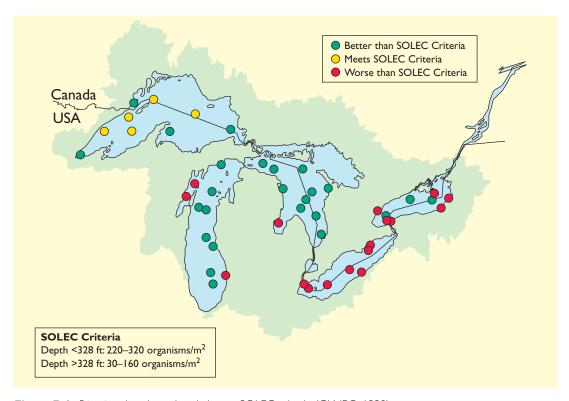

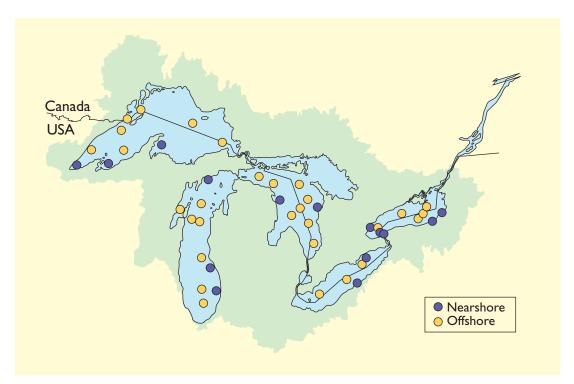**Figure 7-4.** *Diporiea* abundance in relation to SOLEC criteria (GLNPO, 1998).

Figure 7-5. Location of benthic sampling sites, summer 1997 (GLNPO, 1998).

Coastal Habitat Index

More than one-half of the Great Lakes coastal wetlands were lost between 1780 to 1980, with the largest losses in Ohio (90%) and the smallest in Minnesota (42%) (Figure 7-6). Today, Great Lakes scientists rate the condition of Great Lakes coastal wetlands by examining amphibian abundance and diversity, wetland-dependent diversity and abundance, coastal wetland a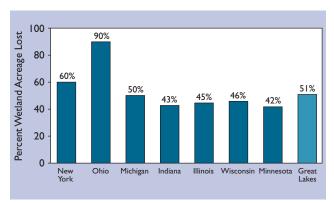rea by type, and the effects of water level fluctuations. Based on these measures, the condition of Great Lakes coastal wetlands is rated fair to poor. A binational Great Lakes Coastal Wetlands Consortium of scientists and managers is developing a long-term monitoring program to assess trends in the rate and extent of loss of the Great Lakes coastal wetlands.

Figure 7-6. Percent coastal wetland habitat loss from 1780 to 1980 by state and for the Great Lakes overall (Turner and Boesch, 1988; Dahl, 1990).

Raspberry Island Lighthouse, Apostle Islands, Wisconsin (Richard B. Mieremet, Senior Advisor, NOAA OSDIA).

Fish Tissue Contaminants Index

The condition of the Great Lakes as measured by fish tissue contaminants is fair. Fish consumption programs are well established in the Great Lakes and offer advice to residents regarding the amount, frequency, and species of fish that are safe to eat. Such advice is based primarily on concentrations of PCBs, mercury, chlordane, dioxin, and toxaphene in fish tissues. These contaminants are generally declining in fish tissues, but are still at levels that trigger fish advisories in all five Great Lakes. Great Lakes scientists rank fish tissue contamination as fair, based on the application of a uniform fish protocol to PCB concentrations in coho salmon from the Great Lakes (contaminants in fish tissue range between 0.2 and 2.0 ppm). Each lake is ranked individually based on PCB concentrations and the corresponding fish advisory category; the final overall ranking is an average of all five individual rankings.

Fish contaminant data can also be used to determine whether fish-dependent wildlife are threatened by toxic chemicals in the environment. Fish-dependent wildlife consume fish as a large part of their diet, and consequently, are susceptible to toxic chemicals in the aquatic environment. The EPA established 0.16 ppm as the wildlife protection value for fish-dependent wildlife, the concentration below which fish-dependent wildlife are reasonably protected. This value is exceeded by a factor of 5 to 10, depending on the specific lake, with highest concentrations in predatory fish from Lake Michigan (Figure 7-7).
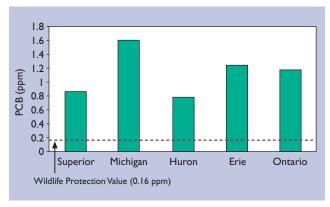

Figure 7-7. PCBs concentrations in Great Lakes top predator whole fish (walleye in Lake Erie, lake trout elsewhere) in 2000 (GLNPO, 2003).

Drinking Water Quality

Drinking water quality in the Great Lakes is fair to good. This indicator is based on the following chemical, biological, physical, and aesthetic parameters: (1) atrazine, nitrate, and nitrite concentrations in raw water; (2) total counts of coliform, *Escherischia coli*, *Giardia*, and *Cryptosporidium* in treated water; (3) turbidity, TOC, and dissolved organic carbon in raw water; and (4) taste and odor of treated water. The desired objective is that all drinking water be safe for human consumption. In other words, densities of disease-causing organisms or concentrations of hazardous or toxic chemicals should not exceed objectives, standards, or guidelines for protecting human health.

The risk to human health from chemical contaminants in Great Lakes drinking water sources is minimal, based on analysis of treated water for atrazine at 104 public water systems and nitrite at 56 public water systems. Data from 98 systems suggested that nearly 36% of public water systems needed to treat water for TOC and dissolved organic carbon (which have the potential to form harmful by-products during water treatment), and treatment was effective in reducing these compounds to safe levels. Three-year data from 48 water treatment plants show higher coliform counts in Great Lakes surface waters and rivers. Water treatment plants reported no to very low occurrences of *Giardia* and *Cryptosporidium* in raw water and no occurrences of these organisms in treated drinking water; consequently, Great Lakes scientists ranked drinking water quality as fairly good.
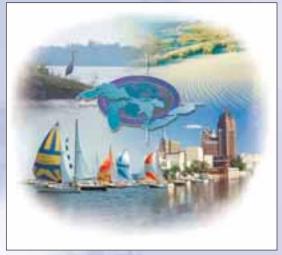
Air Toxics Deposition

The condition of the Great Lakes as measured by air toxics deposition is fair. Trends in concentrations of PCBs over space and time are used to infer the potential for impacts of chemicals from atmospheric deposition and effectiveness and progress toward eliminating toxics from the Great Lakes. The major pathways for PCBs into the Great Lakes are atmospheric deposition (80% to 95%, based on data from Lake Superior and Lake Michigan), sediment contamination, and tributary loadings. SOLEC scientists rank air toxics deposition as fair based on a rating guideline that measured air toxics concentrations ranging between 55 and 100 pg/m^3.

highlight

State of the Lakes Ecosystem Conference (SOLEC)

The SOLEC events are co-hosted biennially by EPA and Environment Canada, as required by the binational Great Lakes Water Quality Agreement (GLWQA) of 1978, as revised in 1987. The purpose of the agreement is to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes basin ecosystem. These conferences report on the state of the Great Lakes ecosystem and major factors affecting it, as well as provide a forum to inform Great Lakes decision makers of the effectiveness of protection and restoration programs for the ecosystem.

Scientists, environmental managers, and other interested stakeholders from the United States and Canada participate in these conferences, which are often focused on specific, but slightly different issues. SOLEC 1994 focused on aquatic community health, human health, aquatic habitat, toxic contaminants in the water, and the Great Lakes economy. The second conference, SOLEC 1996, focused on the nearshore lands and ecosystem water, where there is high biological productivity and diversity and where human impacts are the greatest. Nearshore waters, coastal wetlands, land adjacent to the Great Lakes, impacts of changing land use, and information availability and management were topics stressed at this conference. Following SOLEC 1996, participants identified the need to develop comprehensive, basin-wide indicators to determine and report on progress in a compatible format; therefore, the objective of SOLEC 1998 was to develop a suite of indicators that fairly represent the condition of the Great Lakes ecosystem components.

SOLEC 1998 initiated a systematic program to assess the state of the Great Lakes using science-based indicators. The challenge of SOLEC 2000 was to determine how many of the 80 recommended indicators from the 1998 conference could be quantified. SOLEC 2002 continued the update and assessment of the state of the Great Lakes using the suite of indicators and emphasized biological integrity. A comprehensive assessment of the state of the Great Lakes basin was reported at the 2002 conference.

The results of SOLEC 2002 conference provide much of the information reported in the Great Lakes Coastal Condition chapter. Summaries of the indicator findings and the ecological condition of each of the Great Lakes and their connecting channels are presented in the document *State of the Great Lakes 2003*. The full indicator report, plus references and data sources, are presented in *Implementing Indicators – A Technical Report*. Both are available online at http://www.binational.net. Additional information about SOLEC is also available at http://www.epa.gov/glnpo/solec/.

Assessments and Advisories

Clean Water Act Section 305(b) Assessments

The Great Lakes states assessed 5,066 miles (92%) of their 5,521 miles of Great Lakes shoreline for the 2000 305(b) reports. None of the assessed shoreline waters fully support their designated uses; 22% are threatened for one or more uses, and the remaining 78% are impaired by some form of pollution or habitat degradation (Figure 7-8). Individual use support for Great Lakes shoreline is shown in Figure 7-9. The states reported that priority toxic organic chemicals, nutrients, pathogens, sedimentation, oxygen-depleting substances, foul taste and odor, and PCBs were the leading causes of impairment to Great Lakes shoreline waters.

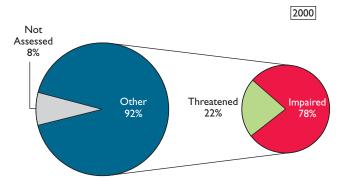Table 7-1 shows how states rated individual use support for their assessed Great Lakes shoreline waters.

Figure 7-9. Individual use support for assessed Great Lakes shoreline waters (U.S. EPA, 2002).

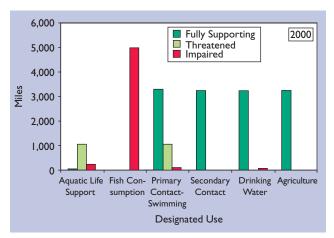**Figure 7-8.** Water quality for assessed Great Lakes shoreline waters (U.S. EPA, 2002).

Table 7-1. Individual Use Support for Assessed Shoreline Waters Reported by States on the Great Lakes under Section 305(b) of the Clean Water Act for 2000 (U.S. EPA, 2002).

Individual Uses	Shoreline Assessed as Impaired (mi)	Percentage of Total Area Assessed
Aquatic life support	245	18%
Fish consumption	4,976	100%
Primary contact – swimming	101	3%
Secondary contact	6	0%
Drinking water	80	2%
Agriculture	0	0%

Park Point area, Lake Superior, Minnesota (Richard B. Mieremet, Senior Advisor, NOAA OSDIA).

Fish Consumption Advisories

Fishing in the Great Lakes region is a way of life and a valued recreational and commercial activity for many people. To protect citizens from the risks of eating contaminated fish, the eight states bordering the Great Lakes had a total of 30 fish consumption advisories in effect in 2002 for the waters and connecting waters of the Great Lakes. During 2002, every Great Lake had at least one advisory, and advisories covered 100% of the Great Lakes shoreline (Figure 7-10). Michigan, which borders four of the five Great Lakes and encompasses four of the six connecting waterbodies, issued the largest number of advisories (13).

Great Lakes fish consumption advisories were issued for six pollutants: mercury, mirex, chlordane, dioxins, PCBs, and DDT. All of the advisories listed PCBs, and almost one-half (47%) also listed dioxins (Figure 7-11). Lake Superior, Lake Michigan, and Lake Huron were under advisory for at least four pollutants each in 2002 (Table 7-2); however, some of the advisories were of limited geographic extent, and advisories in most locations applied primarily to larger, older, individual fish high in the food chain.

Species under fish consumption advisory in 2002 in at least one of the Great Lakes or connecting waters:

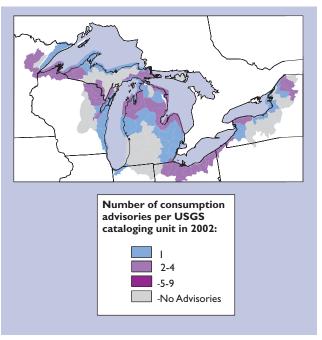|	
American eel	Largemouth bass
Black crappie	Longnose sucker
Bloater	Northern hogsucker
Blue catfish	Northern pike
Bluegill sunfish	Pink salmon
Bowfin	Quillback carpsucker
Brook trout	Rainbow trout
Brown bullhead	Rock bass
Brown trout	Round goby
Burbot	Silver redhorse
Channel catfish	Siscowet trout
Chinook salmon	Smallmouth bass
Chub	Smelt
Coho salmon	Splake trout
Common carp	Steelhead trout
Freshwater drum	Walleye
Gizzard shad	White bass
Lake herring	White perch
Lake sturgeon	White sucker
Lake trout	Yellow perch
Lake whitefish	Source: U.S. EPA, 2003c.

Figure 7-10. Fish consumption advisories were in effect for 100% of U.S. Great Lakes shoreline waters in 2002 (U.S. EPA, 2003c).
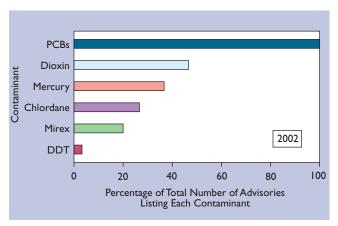

Figure 7-11. Great Lakes advisories were issued for five contaminants. An advisory can be issued for more than one contaminant, so percentages may not add up to 100 (U.S. EPA, 2003c).

Table 7-2. Fish Advisories Issued for Contaminants in Each of the Great Lakes (U.S. EPA, 2003c).

Great Lakes	PCBs	Dioxins	Mercury	Chlordane	DDT	Mirex
Lake Superior	●	●	●	●		
Lake Michigan	●	●	●	●	●	
Lake Huron	●	●	●	●		
Lake Erie	●	●	●			
Lake Ontario	●	●				●

Beach Advisories and Closures

Of the 386 coastal beaches along the Great Lakes that reported information to EPA, only 28.5% (110 beaches) were closed or under an advisory for some period of time in 2002. Table 7-2 presents the numbers of beaches, advisories, and closures for each state. Indiana, Wisconsin, and Illinois had the greatest percentages of advisories or closures. Figure 7-12 presents advisory and closure percentages for each county within each state.

Most beach advisories and closures were implemented at coastal beaches along the Great Lakes because of elevated bacteria levels (Figure 7-13). Most beaches had multiple sources of water-borne bacteria that resulted in advisories or closures. Stormwater runoff (23%) and wildlife (22%) were frequently identified as sources, and unknown sources accounted for 25% of the responses (Figure 7-14).

The highest percentage of beaches closed or under advisory occurred in Indiana, Wisconsin, and Illinois, with almost 71%, 53%, and 51% of beaches, respectively, reporting at least one public beach notification in 2002 (Table 7-3). Pennsylvania and Minnesota both reported that 0% of their beaches were closed or under advisories in 2002.

Percentage of beaches reporting with at least one advisory or closure per county in 2002:

- 0
- 1-10
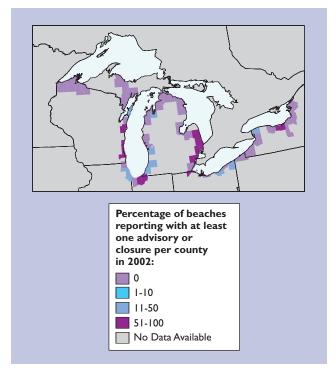- 11-50
- 51-100
- No Data Available

Figure 7-12. Percentage of Great Lakes beaches responding to the survey with at least one advisory or closure (U.S. EPA, 2003a).
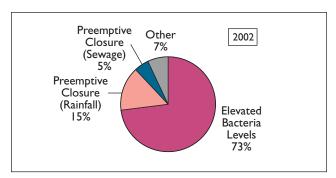

Figure 7-13. Reasons for beach advisories or closures in the Great Lakes (U.S. EPA, 2003a).
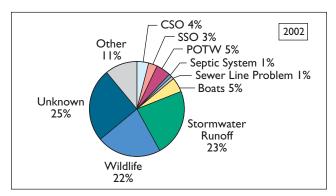
Figure 7-14. Sources of beach contamination in the Great Lakes (U.S. EPA, 2003a).

Table 7-3. Number of Beaches and Advisories/Closures in 2002 for Great Lakes Coastal States (U.S. EPA, 2003a).

State	No. of Beaches	No. of Advisories/ Closures	Percentage of Beaches Affected by Advisories/ Closures
Minnesota	4	0	0.0 %
Wisconsin	53	28	52.8 %
Illinois	43	22	51.2 %
Indiana	17	12	70.6 %
Michigan	174	26	14.9 %
Ohio	52	12	23.1 %
Pennsylvania	13	0	0.0 %
New York	30	10	33.3 %
TOTALS	386	110	28.5 %

highlight

Great Lakes Strategy 2002: A Plan for the New Millennium

The Great Lakes Strategy 2002 was created by the United States Policy Committee (USPC), a forum of senior representatives from federal, state, and tribal governmental agencies that share the responsibility for environmental protection and management of the natural resources of the Great Lakes Basin. The strategy's purpose is to advance the restoration and protection of the Great Lakes Basin ecosystem, as related to fulfilling the goals of the GLWQA of 1972, as amended in 1987. It is intended to coordinate and focus USPC efforts by establishing a common set of goals for multi-lake and basin-wide environmental issues. The strategy supports multi-stakeholder efforts to restore and protect the Great Lakes, such as Lakewide Management Plans and Remedial Action Plans for AOCs. International issues will be discussed between the USPC and Canadian counterparts at the Binational Executive Committee meetings that typically occur twice a year.

The long-term vision of the Great Lakes Strategy is to eliminate the need to issue health advisories for fish consumption, beaches, or drinking water; to create a balanced, self-sustaining fishery; to restore and protect native species, natural communities, and ecological systems; to make land use and water quality decisions based on a comprehensive understanding of the ecosystem; and to maintain environmental and economic prosperity in a sustainable balance.

The strategic priorities are expressed within four major long-term goals:

1. **Chemical Integrity.** Reduce toxic substances in the Great Lakes ecosystem to maintain a balance of nutrients to ensure a healthy aquatic ecosystem and protection of all organisms.

2. **Physical Integrity.** Restore and protect the physical integrity of the Great Lakes, supporting habitats of healthy and diverse aquatic communities and wildlife in the Great Lakes Basin.

3. **Biological Integrity.** Restore and maintain stable, diverse, and self-sustaining populations of native fish and aquatic life, wildlife, and plants in the Great Lakes Basin.

4. **Cooperative Management.** Work together to restore and protect the Great Lakes Basin by establishing effective programs, coordinating authorities and resources, reporting on progress, and holding forums for information exchange and collective decision making to achieve the objectives of the GLWQA.

For each goal, the strategy identifies major environmental challenges, describes the challenge, lists major governmental programs to address the issue, establishes ambitious objectives, including a scheduled deadline with a measurable environmental result, and identifies key actions to accomplish the objectives. Additional information on the Great Lakes Strategy 2002 is available at http://www.epa.gov/grtlakes/gls.

highlight

Volunteer Monitoring Program for Aquatic Nuisance Species

The Lake Erie Aquatic Exotics Squad Volunteer Monitoring Program is a collaborative project between the Pennsylvania Department of Environmental Protection's (DEP's) Coastal Zone Management Program, Lakes Management Program, Citizen Volunteer Monitoring Program, and Pennsylvania Sea Grant. The pilot phase of this program was conducted in 2003 and trained citizens, watershed organizations, and students in the coastal Lake Erie watershed to identify and monitor aquatic nuisance species (ANSs). The monitoring data collected by volunteers were used to enhance the DEP's database on established invaders. The data will also be used to create an early detection network and to assist in future management and education initiatives to minimize the spread and harmful impacts of ANSs.

The pilot program focused on zebra mussels and six aquatic plants: curly-leaf pondweed, Eurasian watermilfoil, *Hydrilla*, *Phragmites*, purple loosestrife, and water chestnut. Several of these species were already present in the watershed, but others, such as water chestnut, were potential invaders. Twenty-two volunteers participated in a 1-day workshop to gain hands-on training in ANS identification and monitoring protocols. The participants received a training manual containing fact sheets, protocols, and data-reporting forms; a field guide to ANSs in the region; and a set of stream or lake monitoring equipment. Following the workshop, volunteers selected one to two sites to monitor twice a month from June to August 2003. They then submitted their data monthly to DEP for analysis. At the end of the summer, DEP compiled a final report containing data from all the sampling sites.

For more information, contact Kirstin Wakefield at c-kwakefie@state.pa.us.

Purple loosestrife stand along the shore of Lake Erie.

Summary

Although the Great Lakes has an extensive monitoring network with respect to objectives, design, or approaches, Great Lakes monitoring is not directly comparable with monitoring done by the NCA Program. For example, the GLNPO monitors indicators at locations selected according to best scientific judgment to represent the overall condition of the Great Lakes, whereas the NCA Program monitors indicators at sites selected using a probabilistic sampling design in order to yield direct, representative estimates of overall condition with known levels of uncertainty. Consequently, spatial estimates of coastal condition that are consistent with those calculated for the East Coast, West Coast, and Gulf Coast regions cannot be calculated for the Great Lakes nor can calculations for the Great Lakes be concisely compared with calculations from other regions. Best professional judgment of knowledgeable scientists, however, was recently used to assess the overall status of eight ecosystem components in relation to established endpoints or ecosystem objectives, when available. The Great Lakes were rated fair using available assessment information. The purpose of this exercise was to establish a baseline for the overall health of the Great Lakes to determine if conditions improve in the future as a result of management and control strategies. The results of these assessments will be used as a basis to compare and integrate overall condition of the Great Lakes with other coastal resources in this report.